

**Stream Habitat and Aquatic Benthic Macroinvertebrate Communities in Nine
Streams of the Broad River, Coosawattee River, and Toccoa River
Watersheds, Chattahoochee-Oconee National Forest, Georgia, April, 2004**



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Introduction

Resource managers of the Chattahoochee-Oconee National Forest (CONF) historically have used aquatic benthic macroinvertebrate communities as biological indicators to assess and monitor the health of wadeable streams (Whalen et al. 2002). The CONF requested the assistance of the USFS Southern Research Station Center for Aquatic Technology Transfer (CATT) in collecting macroinvertebrate samples in spring 2004 as a part of the ongoing stream monitoring process and to provide additional data to a graduate research project in the Department of Entomology at Virginia Tech. Stream habitat information associated with the macroinvertebrate samples were collected to describe the conditions at the sample locations.

Study Sites

Benthic macroinvertebrates were collected from nine CONF streams (15 sample sites) during April 2004 (Figures 1 & 2, Table 1). Of the nine streams, three (six sample sites) were located in the Coosawattee River watershed, five (six sample sites) were located in the Broad River watershed, and one (three sample sites) was located in the Toccoa River watershed.

Methods

Macroinvertebrates

Macroinvertebrate samples were collected using a methodology developed in collaboration with Dr. Reese Voshell, Department of Entomology, Virginia Polytechnic Institute and State University (Roghair et al. 2002). The starting point for a 100 m-long sample site was randomly selected from within designated stream reaches. D-frame dipnet samples were collected every three meters within the 100 m sample site, for a total of 33 samples per site. A random numbers table was used to determine the location of the sample within the wetted channel (distance from right bank) for each of the 33 samples. All 33 samples collected within the 100 m sample site were combined to form a single composite sample for each site.

Samples were collected by a two-person crew using a D-frame dipnet. One individual held the dipnet with the opening facing upstream and timed the second individual, who disturbed the substrate within a 0.3 m² area in front of the dipnet. If the substrate in front of the net was completely sand, it was agitated to a depth of 5-10 cm (finger length) for 5 seconds. All other samples were collected by disturbing the area in front of the net for 15 seconds; cobbles, boulders, woody debris, and large organic materials were lifted and thoroughly rubbed, and smaller substrates were agitated, taking care to sweep sample materials into the dipnet.

Where possible global positioning system (GPS) points were recorded at the start of each sample reach (Table 1). All points were recorded using the UTM coordinates system and NAD 27 CONUS map datum.

Habitat

Stream habitat was inventoried in each 100 m sample reach using a modified version of the basin-wide visual estimation technique (BVET) (Dolloff et al. 1993). The type of each habit unit within the 100 m sample reach was identified and wetted width, average and maximum depth, dominant and subdominant substrates, and the degree to which substrates were embedded were visually estimated. Habitat unit types included pools, glides, riffles, runs, and cascades (Table 2). The length (0.1 m) of each habitat unit was measured with a hip chain and wetted width was visually estimated. Average depth of each habitat unit was estimated by taking depth measurements at various places across the channel profile with a graduated staff marked in 5 cm increments. Substrate was categorized into nine size classes (Table 3). Dominant substrate (covering the greatest surface area in unit) and subdominant substrate (covering the 2nd greatest surface area in unit) were visually estimated. The percent of the total substrate surface area that was embedded was visually estimated for each habitat unit. Substrate was considered embedded if clay, silt, or sand filled the interstitial spaces between larger particles. Large woody debris (LWD) within the bankfull stream channel was classified and inventoried for all sample reaches. LWD was divided into seven size categories (Table 4). All woody debris less than 1 m long and less than 5 cm in diameter was omitted from the survey. Bank instability was visually estimated for both left and right banks. Bank instability was defined as the percent of the bank between the edge of the wetted channel and the top of the bankfull channel that consisted of erodible materials. Rosgen channel type for each sample reach was estimated visually based on channel type descriptions found in Rosgen (1996) (Table 5). All data were recorded using a Husky Fex21 data logger.

Results

Survey results are presented in the following appendices:

- A) Stream habitat survey summaries,
- B) Macroinvertebrate report, produced under supervision of Dr. Reese Voshell, Department of Entomology, Virginia Polytechnic Institute and State University, includes detailed sample and metric calculation results.

Conclusions

Macroinvertebrate sampling of CONF streams was intended to provide baseline information on the condition of stream communities. Resource managers can use this information to evaluate overall stream health and the effects of management activities in Forest watersheds. Sample site locations and descriptions are provided along with stream channel characteristics allowing the monitoring of macroinvertebrate communities at the same sites over time or comparisons to similar stream reaches within the Forest. These data are part of a larger dataset currently being analyzed by Scott Longing (Dept. of Entomology, Virginia Tech) to evaluate protocols and methodologies for sampling in the CONF. Until this analysis is complete, we recommend the CONF continue to collect macroinvertebrate samples in a similar manner to provide resource managers with comparable inventory and monitoring information.

Literature Cited

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Table 1. Sample site locations. GPS coordinates recorded in UTM, NAD27, meters except where noted otherwise.

Site	Watershed	East	North	Quadrangle	Comments
Anderson Creek 01	Coosawattee River	747841	3829425	Amicalola	Hwy 52 to Dawson/Gilmer county line- on private land, walked private drive to bridge crossing- went 100 m upstream – Kdam and bank work done here- recent timber harvest on left
Anderson Creek 02	Coosawattee River	752418	3830960	Nimblewill	Access via High Shoals Road – very rough road – came thru Amicalola State Park, past Baptist church at ford- went 200 m downstream, very small stream – mostly less than 1 m wide
Anderson Creek 03*	Coosawattee River	748049	3832614	Amicalola	About 25 m upstream from confluence with ‘Duff Creek’ half log bridge with rope here – pretty big water – just one riffle and one small pool in 100 m <i>*survey not completed due to nightfall</i>
Big Leatherwood Creek	Broad River	279840	3820840	Ayersville	Access via Horse Camp Rd. off 184 Forest Road 389/389A to cul de sac parking area – hike ¼ mile to stream same site as spring 2002.
Dicks Creek	Broad River	278036	3823405	Ayersville	Access via roadcrossing on National Guard Rd. sampled 100 m upstream of bridge
Duff Creek 01	Coosawattee River	751665	3832363	Amicalola	Headwaters of Anderson Creek access via FS road 35- unnamed on quadmap, GPS recorded at DS end of each reach unless otherwise noted
Duff Creek 02	Coosawattee River	749365	3832513	Amicalola	Old OHV area being rehabbed by FS. Accessed via very narrow and rough road across private land – Doug David parked at obliterated ford and walked upstream several hundred meters
Kimbell Creek	Broad River	276937	3820380	Ayersville	100 m upstream of furthest upstream crossing on 87
Middle Fork Broad River	Broad River	276433	3822886	Ayersville	Access via Brown Bottoms Rd. Parked at bridge sampling 100 m upstream of road crossing. Trout anglers here
North Fork Broad River 01	Broad River	281747	3827995	Ayersville	Access past road to the ‘summit’ – walked down railroad tracks to huge trestle – went upstream of trestle – same site as 2002

Table 1 cont...

North Fork Broad River 02	Broad River	279657	3828868	Ayersville	Access via Locust Stake Rd. past OHV area parking – stopped where OHV trail #5 comes to road – walked to low spot in trail then down closed trail on ridge right to stream – ended up on a big bedrock cascade – collected upstream of cascade
Stanley Creek 01	Toccoa River	745032	3850257	Blue Ridge	Drove in on FS road 338 – parked about 1 mile out because of rough road – easy hike to old bridge crossing/ford – this site downstream of road crossing
Stanley Creek 02	Toccoa River	744822	3849982	Blue Ridge	See site 01 for access – we are now ~125 m upstream of Ford/Bridge
Stanley Creek 03	Toccoa River	W084°18.376**	34°46.888**	Blue Ridge	Charlene Breeden collected this sample the week of 4/12/2004 and added it to samples <i>**GPS recorded in lat/lon</i>
Unnamed Tributary of Briar Creek 01	Coosawatee River	739420	3848078	Cashes Valley	Access via Rich Mountain Rd. – came in past Vulcan Quarry – stream very small – OHV closure area – very bad erosion here – downstream of crossing
Unnamed Tributary of Briar Creek 02	Coosawatee River	739719	3847852	Cashes Valley	See site 01 – this site upstream of Rich Mountain Rd. crossing bedrock cascade upstream of ford, the stream forks – went up left fork

Table 2. Description of habitat types used during BVET habitat surveys on Chattahoochee-Oconee NF, April, 2004, modified from Armantrout (1998).

Habitat Type	Stream Bed Profile	Gradient (%)	Surface Turbulence	Water Velocity
Pool	concave	<1	none	low
Glide	flat	<1	none	low
Run	flat	>1	low to none	high
Riffle	convex	>1	moderate to high	high
Cascade	convex	>12%	very high	very high

Table 3. Substrate size categories used during BVET habitat surveys on the CONF, April 2004.

Type	Number	Size (mm)	Description
Organic Matter	1		dead leaves, detritus, etc. – not live plants
Clay	2		sticky, holds form when rolled into a ball
Silt	3		slippery, does not hold form when rolled into a ball
Sand	4	silt – 2	grainy, does not hold form when rolled into ball
Small Gravel	5	3-16	sand to thumbnail
Large Gravel	6	17-64	thumbnail to fist
Cobble	7	65-256	fist to head
Boulder	8	>256	larger than head
Bedrock	9		solid rock, parent material, may extend into bank

Table 4. Large woody debris (LWD) size classes used during BVET habitat surveys on Chattahoochee-Oconee NF, April, 2004. Diameter was measured at thickest portion of LWD piece. All woody debris less than 1 m long and less than 5 cm in diameter were omitted from the survey.

Size Class	Length (m)	Diameter (cm)
1	< 5	5 – 10
2	< 5	10 – 50
3	< 5	> 50
4	> 5	5 – 10
5	> 5	10 – 50
6	> 5	> 50
7	rootwad	rootwad

Table 5. Rosgen (1996) channel type descriptions used during BVET habitat surveys on Chattahoochee-Oconee NF, April, 2002.

	A	B	C	D	E	F	G
Entrenchment	< 1.4	1.4 – 2.2	> 2.2	n/a	> 2.2	< 1.4	< 1.4
W/D Ratio	< 12	> 12	> 12	> 40	< 12	> 12	< 12
Sinuosity	1 – 1.2	> 1.2	> 1.2	n/a	> 1.5	> 1.2	> 1.2
Slope	.04 - .099	.02 – 0.39	< .02	< .04	< .02	< .02	.02 - .039

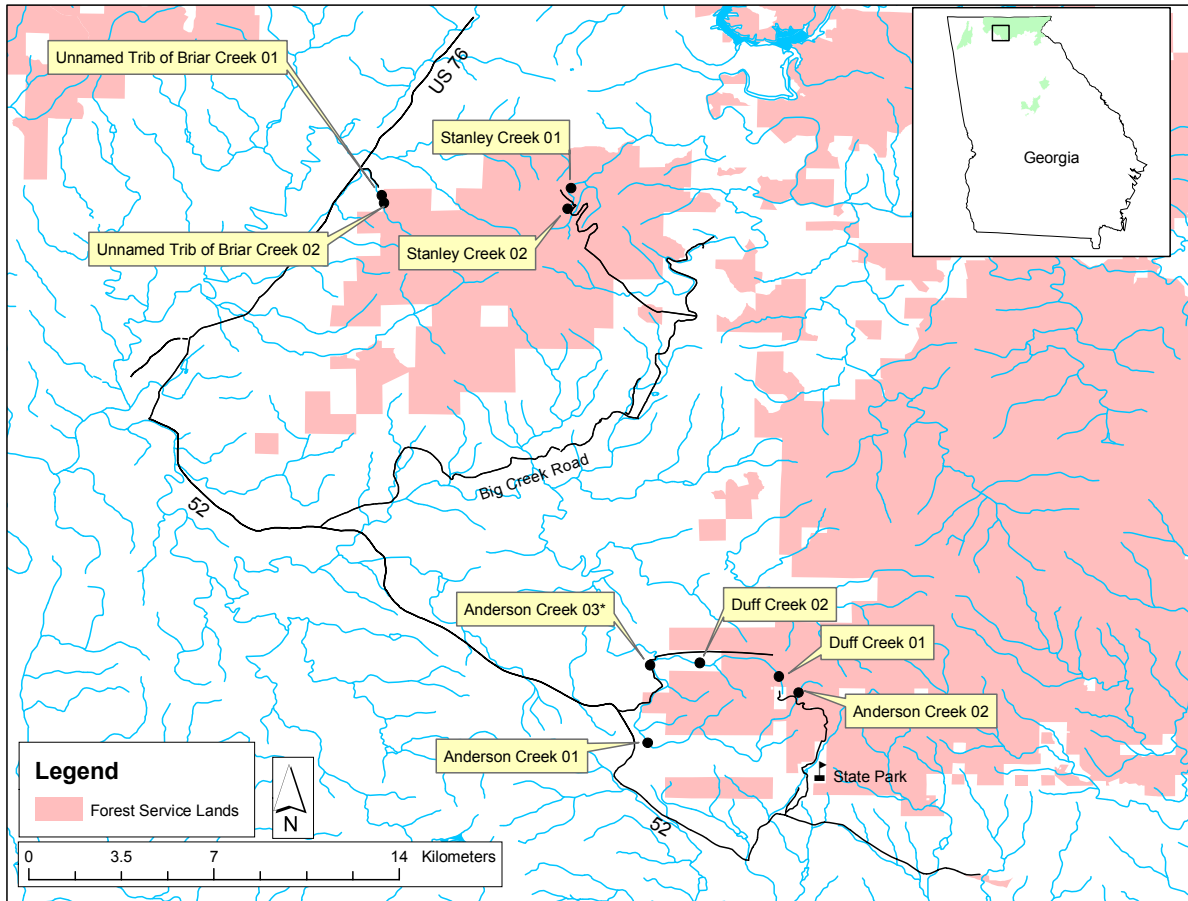


Figure 1: Macroinvertebrate sample sites on Anderson Creek, Duff Creek, Stanley Creek and an Unnamed Tributary of Briar Creek., April 2002.

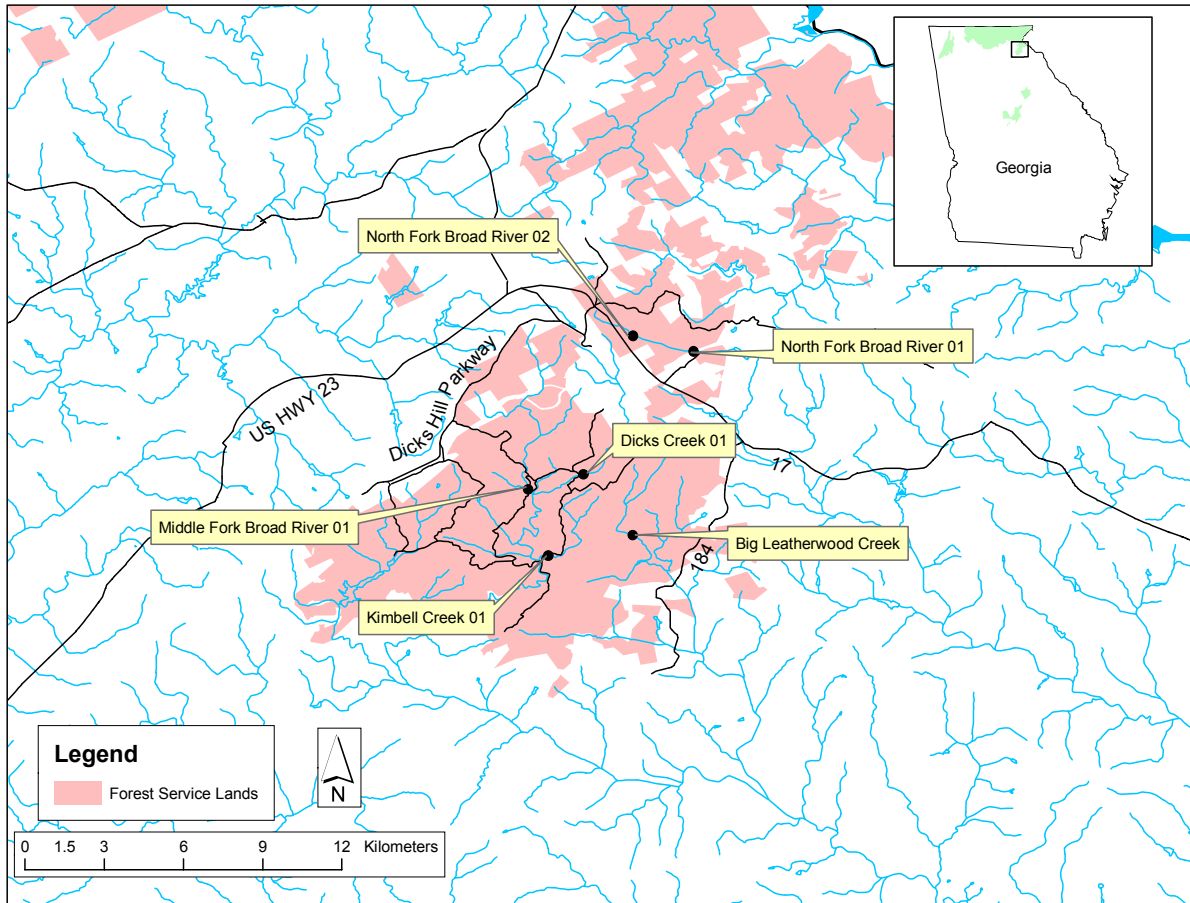


Figure 2: Macroinvertebrate sample sites on Big Leatherwood Creek, Dicks Creek, Kimbell Creek Middle Fork of Broad River and North Fork Broad River, April 2002.

Appendix A: Stream Habitat Survey Summaries

Table A1: Stream habitat survey summary for Anderson Creek 01.

Stream:	Anderson Creek Site 01		
District:	Toccoa		
Quadrangle:	Amicalola		
Survey Date:	04/06/04		
Total Distance Surveyed (m):	100		
Percent of Total Area Pools:	46		
Number of Pools:	3		
Total Pool Area (m ²):	349		
Mean Pool Area (m ²):	70		
Mean Maximum Depth (cm):	52		
Mean Average Depth (cm):	33		
Mean % Embeddedness (Pools):	23		
Percent of Total Area Riffles:	54		
Number of Riffles:	2		
Total Riffle Area (m ²):	408		
Mean Riffle Area (m ²):	136		
Mean Maximum Depth (cm):	50		
Mean Average Depth (cm):	32		
Mean % Embeddedness (Riffles):	17		
Number of LWD pieces per 100 m:	6		
1	0		
2	4		
3	0		
4	0		
5	2		
6	0		
7	0		
Mean Wetted Channel Width (m):	5		
Rosgen's Channel Type:	B		
Mean % Bank Stability (Left)	10		
Mean % Bank Stability (Right)	7		

Habitat Type	Unit Number	Dominant Substrate	Subdominant Substrate
Riffle	1	6	7
Pool	1	6	4
Riffle	2	6	7
Pool	2	6	4
Riffle	3	7	6
Pool	3	6	4
Run	4	6	7
Riffle	5	6	7

Table A2: Stream habitat survey summary for Anderson Creek 02.

Stream:	Anderson Creek Site 02		
District:	Toccoa		
Quadrangle:	Nimblewill		
Survey Date:	04/06/04		
Total Distance Surveyed (m):	100		
Percent of Total Area Pools:	8		
Number of Pools:	3		
Total Pool Area (m ²):	9		
Mean Pool Area (m ²):	3		
Mean Maximum Depth (cm):	20		
Mean Average Depth (cm):	12		
Mean % Embeddedness (Pools):	90		
Percent of Total Area Riffles:	92		
Number of Riffles:	4		
Total Riffle Area (m ²):	94		
Mean Riffle Area (m ²):	24		
Mean Maximum Depth (cm):	18		
Mean Average Depth (cm):	5		
Mean % Embeddedness (Riffles):	64		
Number of LWD pieces per 100 m:	19		
1	7		
2	11		
3	0		
4	0		
5	1		
6	0		
7	0		
Mean Wetted Channel Width (m):	1		
Rosgen's Channel Type:	B		
Mean % Bank Stability (Left)	8		
Mean % Bank Stability (Right)	5		

Habitat Type	Unit Number	Dominant Substrate	Subdominant Substrate
R	1	4	5
P	1	4	5
R	2	4	5
P	2	4	7
R	3	4	5
P	3	4	5
R	4	4	5

Table A3: Stream habitat survey summary for Anderson Creek 03.

Stream:	Anderson Creek Site 03
District:	Toccoa
Quadrangle:	Nimblewill
Survey Date:	04/06/04
Total Distance Surveyed (m):	No habitat data were collected due to darkness
Percent of Total Area Pools:	Macroinvertebrate sample collected in 50 m reach
Number of Pools:	
Total Pool Area (m ²):	
Mean Pool Area (m ²):	
Mean Maximum Depth (cm):	
Mean Average Depth (cm):	
Mean % Embeddedness (Pools):	
Percent of Total Area Riffles:	
Number of Riffles:	
Total Riffle Area (m ²):	
Mean Riffle Area (m ²):	
Mean Maximum Depth (cm):	
Mean Average Depth (cm):	
Mean % Embeddedness (Riffles):	
Number of LWD pieces per 100 m:	
1	
2	
3	
4	
5	
6	
7	
Mean Wetted Channel Width (m):	
Rosgen's Channel Type:	
Mean % Bank Stability (Left)	
Mean % Bank Stability (Right)	

Habitat Type	Unit Number	Dominant Substrate	Subdominant Substrate
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Table A4: Stream habitat survey summary for Big Leatherwood Creek.

Stream:	Big Leatherwood Creek		
District:	Chattooga		
Quadrangle:	Ayersville		
Survey Date:	04/08/04		
Total Distance Surveyed (m):	100		
Percent of Total Area Pools:	93		
Number of Pools:	5		
Total Pool Area (m ²):	299		
Mean Pool Area (m ²):	60		
Mean Maximum Depth (cm):	70		
Mean Average Depth (cm):	32		
Mean % Embeddedness (Pools):	48		
Percent of Total Area Riffles:	7		
Number of Riffles:	4		
Total Riffle Area (m ²):	21		
Mean Riffle Area (m ²):	5		
Mean Maximum Depth (cm):	23		
Mean Average Depth (cm):	10		
Mean % Embeddedness (Riffles):	13		
Number of LWD pieces per 100 m:	29		
1	9		
2	9		
3	0		
4	0		
5	10		
6	1		
7	0		
Mean Wetted Channel Width (m):	2		
Rosgen's Channel Type:	F		
Mean % Bank Stability (Left)	36		
Mean % Bank Stability (Right)	23		

Habitat Type	Unit Number	Dominant Substrate	Subdominant Substrate
R	1	6	5
P	1	5	4
R	2	5	6
P	2	4	5
R	3	5	6
P	3	4	5
R	4	6	5
P	4	5	4
P	5	5	3

Table A5: Stream habitat survey summary for Dicks Creek.

Stream:	Dicks Creek
District:	Chattooga
Quadrangle:	Ayersville
Survey Date:	04/08/04
Total Distance Surveyed (m):	100
Percent of Total Area Pools:	93
Number of Pools:	1
Total Pool Area (m ²):	390
Mean Pool Area (m ²):	97
Mean Maximum Depth (cm):	31
Mean Average Depth (cm):	16
Mean % Embeddedness (Pools):	91
Percent of Total Area Riffles:	8
Number of Riffles:	1
Total Riffle Area (m ²):	32
Mean Riffle Area (m ²):	32
Mean Maximum Depth (cm):	20
Mean Average Depth (cm):	15
Mean % Embeddedness (Riffles):	10
Number of LWD pieces per 100 m:	18
1	1
2	10
3	0
4	2
5	4
6	0
7	1
Mean Wetted Channel Width (m):	4
Rosgen's Channel Type:	F
Mean % Bank Stability (Left)	49
Mean % Bank Stability (Right)	31

Habitat Type	Unit Number	Dominant Substrate	Subdominant Substrate
G	1	4	5
RN	1	4	9
G	2	4	9
R	2	9	8
P	3	4	8
G	4	4	5

Table A6: Stream habitat survey summary for Duff Creek 01.

Stream:	Duff Creek Site 01		
District:	Toccoa		
Quadrangle:	Amicalola		
Survey Date:	04/06/04		
Total Distance Surveyed (m):	100		
Percent of Total Area Pools:	27		
Number of Pools:	8		
Total Pool Area (m ²):	74		
Mean Pool Area (m ²):	9		
Mean Maximum Depth (cm):	22		
Mean Average Depth (cm):	14		
Mean % Embeddedness (Pools):	91		
Percent of Total Area Riffles:	73		
Number of Riffles:	9		
Total Riffle Area (m ²):	196		
Mean Riffle Area (m ²):	20		
Mean Maximum Depth (cm):	18		
Mean Average Depth (cm):	10		
Mean % Embeddedness (Riffles):	45		
Number of LWD pieces per 100 m:	62		
1	31		
2	25		
3	0		
4	2		
5	4		
6	0		
7	0		
Mean Wetted Channel Width (m):	3		
Rosgen's Channel Type:	B		
Mean % Bank Stability (Left)	42		
Mean % Bank Stability (Right)	26		

Habitat Type	Unit Number	Dominant Substrate	Subdominant Substrate
R	1	4	7
P	1	4	7
R	2	7	4
P	2	4	7
R	3	7	5
P	3	4	5
R	4	7	4
P	4	4	7
R	5	7	5
P	5	4	7
R	6	7	4
P	6	4	7
R	7	7	5
P	7	4	8
R	8	7	4
P	8	4	5
RN	9	4	5
R	10	7	5

Table A7: Stream habitat survey summary for Duff Creek 02.

Stream:	Duff Creek 02		
District:	Toccoa		
Quadrangle:	Amicalola		
Survey Date:	04/06/04		
Total Distance Surveyed (m):	100		
Percent of Total Area Pools:	20		
Number of Pools:	4		
Total Pool Area (m ²):	58		
Mean Pool Area (m ²):	15		
Mean Maximum Depth (cm):	53		
Mean Average Depth (cm):	34		
Mean % Embeddedness (Pools):	45		
Percent of Total Area Riffles:	80		
Number of Riffles:	5		
Total Riffle Area (m ²):	233		
Mean Riffle Area (m ²):	47		
Mean Maximum Depth (cm):	41		
Mean Average Depth (cm):	23		
Mean % Embeddedness (Riffles):	27		
Number of LWD pieces per 100 m:	38		
1	20		
2	13		
3	0		
4	1		
5	4		
6	0		
7	0		
Mean Wetted Channel Width (m):	3		
Rosgen's Channel Type:	B		
Mean % Bank Stability (Left)	12		
Mean % Bank Stability (Right)	36		

Habitat Type	Unit Number	Dominant Substrate	Subdominant Substrate
R	1	9	4
P	1	8	4
R	2	9	7
P	2	4	7
R	3	7	4
P	3	4	9
R	4	9	4
P	4	8	4
R	5	9	7

Table A8: Stream habitat survey summary for Kimbell Creek.

Stream:	Kimbell Creek		
District:	Chattooga		
Quadrangle:	Ayersville		
Survey Date:	04/08/04		
Total Distance Surveyed (m):	100		
Percent of Total Area Pools:	67		
Number of Pools:	2		
Total Pool Area (m ²):	250		
Mean Pool Area (m ²):	62		
Mean Maximum Depth (cm):	35		
Mean Average Depth (cm):	21		
Mean % Embeddedness (Pools):	74		
Percent of Total Area Riffles:	33		
Number of Riffles:	3		
Total Riffle Area (m ²):	125		
Mean Riffle Area (m ²):	42		
Mean Maximum Depth (cm):	42		
Mean Average Depth (cm):	10		
Mean % Embeddedness (Riffles):	23		
Number of LWD pieces per 100 m:	30		
1	13		
2	14		
3	0		
4	1		
5	2		
6	0		
7	0		
Mean Wetted Channel Width (m):	4		
Rosgen's Channel Type:	F		
Mean % Bank Stability (Left)	55		
Mean % Bank Stability (Right)	76		

Habitat Type	Unit Number	Dominant Substrate	Subdominant Substrate
G	1	4	3
R	1	6	4
P	2	4	3
R	2	5	6
G	3	3	5
R	3	6	7
P	4	9	3

Table A9: Stream habitat survey summary for Middle Fork Broad River.

Stream:	Middle Fork Broad River		
District:	Chattooga		
Quadrangle:	Ayersville		
Survey Date:	04/08/04		
Total Distance Surveyed (m):	100		
Percent of Total Area Pools:	71		
Number of Pools:	2		
Total Pool Area (m ²):	384		
Mean Pool Area (m ²):	128		
Mean Maximum Depth (cm):	68		
Mean Average Depth (cm):	27		
Mean % Embeddedness (Pools):	90		
Percent of Total Area Riffles:	29		
Number of Riffles:	2		
Total Riffle Area (m ²):	158		
Mean Riffle Area (m ²):	53		
Mean Maximum Depth (cm):	37		
Mean Average Depth (cm):	27		
Mean % Embeddedness (Riffles):	23		
Number of LWD pieces per 100 m:	10		
1	4		
2	4		
3	0		
4	0		
5	2		
6	0		
7	0		
Mean Wetted Channel Width (m):	4		
Rosgen's Channel Type:	F		
Mean % Bank Stability (Left)	56		
Mean % Bank Stability (Right)	55		

Habitat Type	Unit Number	Dominant Substrate	Subdominant Substrate
R	1	5	6
P	1	4	5
RN	2	5	6
P	2	4	5
R	3	6	5
G	3	4	5

Table A10: Stream habitat survey summary for North Fork Broad River 01.

Stream:	North Fork Broad River		
District:	Chattooga		
Quadrangle:	Ayersville		
Survey Date:	04/08/04		
Total Distance Surveyed (m):	100		
Percent of Total Area Pools:	64		
Number of Pools:	2		
Total Pool Area (m ²):	302		
Mean Pool Area (m ²):	101		
Mean Maximum Depth (cm):	52		
Mean Average Depth (cm):	25		
Mean % Embeddedness (Pools):	90		
Percent of Total Area Riffles:	37		
Number of Riffles:	3		
Total Riffle Area (m ²):	174		
Mean Riffle Area (m ²):	58		
Mean Maximum Depth (cm):	22		
Mean Average Depth (cm):	10		
Mean % Embeddedness (Riffles):	68		
Number of LWD pieces per 100 m:	28		
1	3		
2	13		
3	0		
4	2		
5	9		
6	0		
7	1		
Mean Wetted Channel Width (m):	5		
Rosgen's Channel Type:	F		
Mean % Bank Stability (Left)	60		
Mean % Bank Stability (Right)	73		

Habitat Type	Unit Number	Dominant Substrate	Subdominant Substrate
R	1	4	5
G	1	4	5
P	2	4	5
R	2	4	5
P	3	4	5
R	3	5	4

Table A11: Stream habitat survey summary for North Fork Broad River 02.

Stream:	North Fork Broad River		
District:	Chattooga		
Quadrangle:	Ayersville		
Survey Date:	04/08/04		
Total Distance Surveyed (m):	100		
Percent of Total Area Pools:	42		
Number of Pools:	6		
Total Pool Area (m ²):	114		
Mean Pool Area (m ²):	19		
Mean Maximum Depth (cm):	33		
Mean Average Depth (cm):	22		
Mean % Embeddedness (Pools):	64		
Percent of Total Area Riffles:	58		
Number of Riffles:	5		
Total Riffle Area (m ²):	154		
Mean Riffle Area (m ²):	31		
Mean Maximum Depth (cm):	16		
Mean Average Depth (cm):	7		
Mean % Embeddedness (Riffles):	26		
Number of LWD pieces per 100 m:	18		
1	4		
2	6		
3	0		
4	0		
5	8		
6	0		
7	0		
Mean Wetted Channel Width (m):	3		
Rosgen's Channel Type:	B		
Mean % Bank Stability (Left)	14		
Mean % Bank Stability (Right)	18		

Habitat Type	Unit Number	Dominant Substrate	Subdominant Substrate
P	1	9	4
R	1	9	4
P	2	9	4
R	2	4	7
P	3	4	9
P	4	4	7
R	3	7	4
P	5	4	7
R	4	7	6
P	6	4	7
R	5	7	4

Table A12: Stream habitat survey summary for Stanley Creek 01.

Stream:	Stanley Creek 01		
District:	Toccoa		
Quadrangle:	Blue Ridge		
Survey Date:	04/07/04		
Total Distance Surveyed (m):	100		
Percent of Total Area Pools:	18		
Number of Pools:	4		
Total Pool Area (m ²):	64		
Mean Pool Area (m ²):	16		
Mean Maximum Depth (cm):	49		
Mean Average Depth (cm):	33		
Mean % Embeddedness (Pools):	31		
Percent of Total Area Riffles:	82		
Number of Riffles:	5		
Total Riffle Area (m ²):	296		
Mean Riffle Area (m ²):	59		
Mean Maximum Depth (cm):	30		
Mean Average Depth (cm):	16		
Mean % Embeddedness (Riffles):	20		
Number of LWD pieces per 100 m:	60		
1	21		
2	29		
3	1		
4	0		
5	8		
6	1		
7	0		
Mean Wetted Channel Width (m):	4		
Rosgen's Channel Type:	B		
Mean % Bank Stability (Left)	9		
Mean % Bank Stability (Right)	6		

Habitat Type	Unit Number	Dominant Substrate	Subdominant Substrate
R	1	7	4
P	1	8	4
R	2	7	6
P	2	8	4
R	3	8	7
P	3	6	4
R	4	7	4
P	4	4	8
R	4	8	9

Table A13: Stream habitat survey summary for Stanley Creek 02.

Stream:	Stanley Creek 02		
District:	Toccoa		
Quadrangle:	Blue Ridge		
Survey Date:	04/07/04		
Total Distance Surveyed (m):	100		
Percent of Total Area Pools:	36		
Number of Pools:	8		
Total Pool Area (m ²):	95		
Mean Pool Area (m ²):	12		
Mean Maximum Depth (cm):	43		
Mean Average Depth (cm):	29		
Mean % Embeddedness (Pools):	37		
Percent of Total Area Riffles:	64		
Number of Riffles:	6		
Total Riffle Area (m ²):	172		
Mean Riffle Area (m ²):	29		
Mean Maximum Depth (cm):	25		
Mean Average Depth (cm):	13		
Mean % Embeddedness (Riffles):	13		
Number of LWD pieces per 100 m:	59		
1	31		
2	21		
3	0		
4	1		
5	6		
6	0		
7	0		
Mean Wetted Channel Width (m):	3		
Rosgen's Channel Type:	B		
Mean % Bank Stability (Left)	12		
Mean % Bank Stability (Right)	7		

Habitat Type	Unit Number	Dominant Substrate	Subdominant Substrate
R	1	7	8
P	1	8	4
R	2	9	6
P	2	9	4
P	3	7	4
R	3	7	8
P	4	4	7
P	5	7	4
R	4	7	8
P	6	8	4
R	5	7	8
P	7	6	4
R	6	7	6
P	8	7	4

Stream:	Stanley Creek 03		
District:	Toccoa		
Quadrangle:	Blue Ridge		
Survey Date:	Macroinvertebrate sample collected by Charlene Breeden 4/12/2004		
Total Distance Surveyed (m):	No habitat data collected		
Percent of Total Area Pools:			
Number of Pools:			
Total Pool Area (m ²):			
Mean Pool Area (m ²):			
Mean Maximum Depth (cm):			
Mean Average Depth (cm):			
Mean % Embeddedness (Pools):			
Percent of Total Area Riffles:			
Number of Riffles:			
Total Riffle Area (m ²):			
Mean Riffle Area (m ²):			
Mean Maximum Depth (cm):			
Mean Average Depth (cm):			
Mean % Embeddedness (Riffles):			
Number of LWD pieces per 100 m:			
1			
2			
3			
4			
5			
6			
7			
Mean Wetted Channel Width (m):			
Rosgen's Channel Type:			
Mean % Bank Stability (Left)			
Mean % Bank Stability (Right)			
<hr/>			
Habitat Type	Unit Number	Dominant Substrate	Subdominant Substrate
<hr/>			

Table A15: Stream habitat survey summary for unnamed tributary of Briar Creek 01.

Stream:	Unnamed tributary of Briar Creek 01		
District:	Toccoa		
Quadrangle:	Cashes Valley		
Survey Date:	04/07/04		
Total Distance Surveyed (m):	100		
Percent of Total Area Pools:	3		
Number of Pools:	1		
Total Pool Area (m ²):	4		
Mean Pool Area (m ²):	4		
Mean Maximum Depth (cm):	25		
Mean Average Depth (cm):	15		
Mean % Embeddedness (Pools):	90		
Percent of Total Area Riffles:	98		
Number of Riffles:	0		
Total Riffle Area (m ²):	146		
Mean Riffle Area (m ²):	73		
Mean Maximum Depth (cm):	30		
Mean Average Depth (cm):	10		
Mean % Embeddedness (Riffles):	50		
Number of LWD pieces per 100 m:	37		
1	14		
2	17		
3	1		
4	0		
5	5		
6	0		
7	0		
Mean Wetted Channel Width (m):	2		
Rosgen's Channel Type:	A		
Mean % Bank Stability (Left)	5		
Mean % Bank Stability (Right)	5		

Habitat Type	Unit Number	Dominant Substrate	Subdominant Substrate
C	1	8	4
P	1	4	7
C	2	8	4

Table A16: Stream habitat survey summary for Unnamed tributary Briar Creek 02.

Stream:	Unnamed tributary Briar Creek 02		
District:	Toccoa		
Quadrangle:	Cashes Valley		
Survey Date:	04/07/04		
Total Distance Surveyed (m):	100		
Percent of Total Area Pools:	1		
Number of Pools:	1		
Total Pool Area (m ²):	1		
Mean Pool Area (m ²):	1		
Mean Maximum Depth (cm):	25		
Mean Average Depth (cm):	15		
Mean % Embeddedness (Pools):	90		
Percent of Total Area Riffles:	99		
Number of Riffles:	0		
Total Riffle Area (m ²):	104		
Mean Riffle Area (m ²):	52		
Mean Maximum Depth (cm):	23		
Mean Average Depth (cm):	5		
Mean % Embeddedness (Riffles):	35		
Number of LWD pieces per 100 m:	43		
1	10		
2	25		
3	0		
4	1		
5	7		
6	0		
7	0		
Mean Wetted Channel Width (m):	1		
Rosgen's Channel Type:	A		
Mean % Bank Stability (Left)	15		
Mean % Bank Stability (Right)	5		

Habitat Type	Unit Number	Dominant Substrate	Subdominant Substrate
C	1	8	4
P	1	4	7
C	2	8	4

Appendix B: Macroinvertebrate Report

FINAL REPORT

Submitted: 25 January 2005

Macroinvertebrate Sample Analysis
USDA Forest Service
Southern Research Station (RWU4202)
Chattahoochee National Forest

Dr. J. Reece Voshell Jr. and Scott D. Longing
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In fulfillment of Research Cost Reimbursable Agreement No. SRS-03-CA-11330139-232,
USDA Forest Service, Southern Research Station (RWU4202)

Sixteen samples of benthic macroinvertebrates collected in spring 2004 from the Chattahoochee National Forest in Georgia were analyzed to the terms of the purchase order. Each of the samples has been stored in an individual vial. All samples will be returned to USDA Forest Service personnel.

Our analyses of each sample included the following:

- 1) washing fine detritus and preservative,
- 2) sorting and subsampling of 200 organisms from debris,
- 3) archiving of sample remains,
- 4) identifying all specimens to lowest possible taxonomic level,
- 5) enumerating specimens in each taxon,
- 6) recording counts, taxa names, and taxa codes on bench sheets
- 7) 17 metrics were calculated.
 - Total Taxa
 - Number of EPT Taxa
 - Number of Clinger Taxa
 - Percent Clingers
 - Percent 1 Dominant Taxon
 - Percent 2 Dominant Taxa
 - Percent Tolerant Organisms
 - Intolerant Taxa
 - Percent Diptera
 - Percent Chironomidae
 - Percent EPT
 - North Carolina Biotic Index (NCBI)
 - Percent Collectors
 - Percent Filterers
 - Percent Scrapers
 - Percent Shredders
 - Percent Predators

Taxonomic identifications were made by means of the following references:

Brigham, A. R., W. U. Brigham and A. Gniska. Eds. 1982. Aquatic insects and oligochaetes of North and South Carolina. Midwest Aquatic Enterprises, Mahomet, Illinois.

Meritt, R. W. and K. W. Cummins, eds. 1984. An introduction to the aquatic insects of North America, 3rd ed. Kendall/Hunt, Dubuque, Iowa.

Pennak, R. W. 1989. Fresh-water invertebrates of the United States, 3rd ed. John Wiley and Sons, New York.

Stewart, K. W. and B. P. Stark. 1989. Nymphs of North American stonefly genera (Plecoptera). Volume 12, Thomas Say Foundation Series, Entomological Society of America, Hyattsville, Maryland.

Wiggins, G. B. 1996. Larvae of North American caddisfly genera (Trichoptera). 2nd ed. University of Toronto Press, Toronto, Ontario.

Table B1. Results of sub-sample analysis for samples collected at sites in the Chattahoochee National Forest, spring 2004.

TAXON	Stanley Creek 01	Stanley Creek 02	Stanley Creek 03	Dicks Creek	Big Leatherwood Creek	Middle Fork Broad River	Kimbell Creek	North Fork Broad River 01	North Fork Broad River 02	Unnamed Tributary Briar Creek 01	Unnamed Tributary Briar Creek 02	Duff Creek 01	Duff Creek 02	Anderson Creek 01	Anderson Creek 02	Anderson Creek 03
OLIGOCHAETA		3	10						3	1	1				3	1
Isopoda																
Collembola	6	1								1	1		1		2	
CAMBARIDAE								1								
Pteronarcys			4										1	2		
Tallaperla	2		1	1					1		2	5	3	1	7	
Amphinemura	5	3				3		3	2	1	3	6	3		6	
Acroneuria	1	2	3										1	1		
Eccoptura xanthenes								1						1		
Perlesta				1												
PERLODIDAE						3		2								2
Yugus										6				2	5	
Isoperla		6	2		2		1	8	3	4	8		1		7	1
Remenus									2							
CHLOROPERLIDAE			1			1								1		1
Sweltsa									2	5					5	
Suwallia	8															
Haploperla										1		2				
Leuctra	8	6	8		5			43	13	48	37	11	5	4	20	1
Ephemera	1	1		1			1									
Ephemerella	31	25	17		12	13	3	20	18	1	4	11	11	9	5	41
Ameletus										2						
LEPTOPHLEBIIDAE		16														
Paraleptophlebia	13		8				2					9	1	5		
Baetis (complex)	9	16	10	11	9	13		12	31	25	3	1	26	32	3	40
Baetisca				1												
Stenonema	19	6	10			4	3	4	5	3	3	5	10	8	1	3
Stenacron			5													
Cinygmula subaequalis	3	8										1				
Lanthus			1							2			1	7	1	
Cordulegaster										1						1
Stylogomphus							1									
Gomphus							1									
Cheumatopsyche			1													
Diplectrona modesta	10	1	6		1				1	7	2	3	4	2	5	
Parapsyche	1	4								3		5			4	
Glossosoma						1						2				2
Goera																1
Rhyacophila	9	5	3						4		2	3		6	2	5
Hydroptila																
Phylocentropus																
Dolophilodes distinctus													5			
Micrasema			1									4			3	
Lepidostoma		1	4											5	1	
Neophylax	1									1	1	1	2			

Pycnopsyche				1						1	1	1			1	
Cynellus						1			1	3						
Polycentropus			1									3				
Psephenus herricki														2		2
Ectopria						1										
Stenelmis			4		5					1						
Optioservus			1					4				2	2	3		6
Promoresia			1													8
Oulimnius latisulcus		3		1	1		2		4			2	6	5	1	
Blepharicera			1													
Tipula						1	1	3	3	1	2	1			5	
Antocha		1	7			1						1				2
Dicranota	1	4	2			1				13	4		6	1	1	
Hexatoma	4	2	2						1		3	4	1	7		
Dixa									2		2	1			1	
Simulium			6	3				3	1				5	2		1
Prosimulium				5		2							2			3
CHIRONOMIDAE	48	62	46	166	187	133	172	82	88	51	90	89	59	61	52	50
CERATOPOGONIDAE														2	3	
Tabanidae					1											

Table B2. Metrics calculated from sub-sample analysis for macroinvertebrates collected in the Chattahoochee National Forest, spring 2004.

METRIC	Stanley Creek 01	Stanley Creek 02	Stanley Creek 03	Dicks Creek	Big Leatherwood Creek	Middle Fork Broad River	Kimbell Creek	North Fork Broad River 01	North Fork Broad River 02	Unnamed Tributary Briar Creek 01	Unnamed Tributary Briar Creek 02	Duff Creek 01	Duff Creek 02	Anderson Creek 01	Anderson Creek 02	Anderson Creek 03
Total Number of Individuals (N)	180	176	166	191	223	178	187	186	185	182	169	172	157	169	144	171
Number of Taxa	19	21	28	10	9	14	10	13	19	23	18	23	23	23	24	19
Number of EPT Taxa (EPT Taxa)	15	14	17	6	5	8	5	8	12	15	11	17	13	14	15	10
Number of Clinger Taxa	6	7	13	4	4	6	2	4	5	7	4	11	10	7	6	9
Percent Clingers	23.89	22.16	32.53	10.47	7.17	12.36	2.67	12.37	22.70	23.08	5.33	16.86	40.13	31.95	11.81	39.18
Percent 1 Dominant Taxon	26.67	35.23	27.71	86.91	83.86	74.72	91.98	44.09	47.57	28.02	53.25	51.74	37.58	36.09	36.11	29.24
Percent 2 Dominant Taxa	43.89	49.43	37.95	92.67	89.24	82.02	93.58	67.20	64.32	54.40	75.15	58.14	54.14	55.03	50.00	53.22
Percent Tolerant Organisms	30.00	37.50	37.95	88.48	84.30	75.28	92.51	45.70	50.27	30.77	54.44	51.74	41.40	38.46	41.67	30.41
# Intolerant Taxa	17	18	24	8	7	12	8	11	15	19	15	22	20	20	20	16
Percent Diptera	29.44	39.20	38.55	91.10	84.30	77.53	92.51	47.31	51.35	35.71	59.76	55.23	47.13	43.20	43.06	32.75
Percent Chironomidae	26.67	35.23	27.71	86.91	83.86	74.72	91.98	44.09	47.57	28.02	53.25	51.74	37.58	36.09	36.11	29.24
Percent EPT (%EPT)	67.22	56.82	51.20	8.38	13.00	21.91	5.35	50.00	44.86	60.99	39.05	42.44	46.50	46.75	52.08	56.73
North Carolina Biotic Index (NCBI)	3.34	3.49	3.84	5.74	5.50	5.37	5.74	3.87	4.56	3.13	4.07	4.04	4.12	4.05	3.57	4.02
Percent Collectors	60.00	71.02	62.05	93.72	93.27	89.89	95.19	61.29	76.76	43.41	59.76	64.53	63.06	63.31	45.83	78.36
Percent Filterers	6.11	2.84	7.83	4.19	0.45	1.69	0.00	1.61	1.62	7.14	1.18	4.65	10.19	2.37	6.25	2.34
Percent Scrapers	12.78	9.66	10.24	0.52	2.69	3.37	2.67	4.30	4.86	3.85	2.37	7.56	12.74	10.65	1.39	12.87
Percent Shredders	8.33	5.68	10.84	1.05	2.24	2.25	0.53	26.34	10.27	28.02	26.63	16.28	7.64	7.10	29.86	0.58
Percent Predators	12.78	10.80	9.04	0.52	1.35	2.81	1.60	5.91	6.49	17.58	10.06	6.98	6.37	16.57	16.67	5.85

Table B3. Definitions of metrics used to interpret macroinvertebrate sample results (adapted from Barbour et al. (1999)).

Metric	Definition
Total Number of Individuals	Count of total number of macroinvertebrates in sample; richness measure; generally decreases due to perturbation
Number of Taxa	Count of total number of different genera captured; richness measure; generally decreases due to perturbation
Number of EPT Taxa	Total number of Ephemeroptera, Plecoptera, and Tricoptera taxa collected; richness measure; generally decreases due to perturbation
Number of Clinger Taxa	Total number of taxa with 'clinger' habit (i.e. having fixed retreats or adaptations for attaching to surfaces in flowing water); habit measure; generally decreases due to perturbation
Percent Clingers	Percent of taxa with 'clinger' habit (i.e. having fixed retreats or adaptations for attaching to surfaces in flowing water); habit measure; generally decreases due to perturbation
Percent 1 Dominant Taxa	Number of individuals in the taxa with the greatest number of individuals divided by the total number of individuals; tolerance measure; generally increases due to perturbation
Percent 2 Dominant Taxa	Number of individuals in the two taxa with the greatest number of individuals divided by the total number of individuals; tolerance measure; generally increases due to perturbation
Percent Tolerant Organisms	Percent of individuals considered to be tolerant to various perturbations (here, rated >5 on scale from 0-10); tolerance measure; generally increases due to perturbation
Intolerant Taxa	Total number of genera considered to be sensitive to perturbation; tolerance measure; generally decreases due to perturbation
Percent Diptera	Number of 'true fly' individuals divided by total number of individuals; composition measure; generally increases due to perturbation
Percent Chironomidae	Total number of Chironomids divided by total number of individuals; composition measure; generally increases due to perturbation
Percent EPT	Total number of Ephemeroptera, Plecoptera, and Tricoptera divided by total number of individuals; composition measure; generally decreases due to perturbation
North Carolina Biotic Index	Index that evaluates biological health of stream based on macroinvertebrate community; rating based on scale from 0 to 10 with 0 representing the best water quality and 10 representing the worst
Percent Collectors	Total number of individuals that collect or gather fine particulate matter divided by total number of individuals; functional feeding group measure; variable response to perturbation
Percent Filterers	Total number of individuals that filter fine particulate matter divided by total number of individuals; functional feeding group measure; generally variable response to perturbation
Percent Scrapers	Total number of individuals that graze upon periphyton divided by total number of individuals; functional feeding group measure; variable response to perturbation
Percent Shredders	Total number of individuals that shred coarse particulate matter divided by total number of individuals; functional feeding group measure; variable response to perturbation
Percent Predators	Total number of individuals that feed on other organisms divided by total number of individuals; functional feeding group measure; variable response to perturbation